OCCASIONAL PAPER NO. 52 OCTOBER 15, 1935

SOUTHERN FOREST EXPERIMENT STATION

E. L. Demmon, Director

New Orleans, La.

WHAT, WHERE, WHEN, AND WHY ARE TERMITES?

by

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What and Why are Termites?

The title of this informal address is purposely very presumptuous, since I hope to show that there are many gaps in our knowledge of termites.

It is believed that most residents of New Orleans know what termites are. Nevertheless, in an examination given this year for real estate brokers, one answer to the question, "What is a termite?" was, "An instrument which is set in the wall to indicate how hot or cold the room is." Termites are not thermometers.

Termites represent one of the important groups of social insects, other social groups being ants, bees, and wasps. While superficially resembling true ants, termites belong to an entirely distinct order of insects and are closely related to the Blattidae, or roaches. Indeed, they might be called social roaches. The primitive wingless roaches are wood-boring insects and they care for their young in colonies, as did both ancestral roaches and termites. The wings of primitive termites and modern roaches are similar. The females of both groups extrude eggs in adhering masses or cases. Both insects have free living symbiotic intestinal protozoa. Although they had a common ancestor, roaches are much older, geologically, than termites.

Although termites are called "white ants," and are somewhat antlike in form, they are not related to the more numerous and geologically much more recent ants. Ants have a slim thorax or "waist," while termites have a broad thorax. The fore wings of ants are markedly larger than their hind wings, whereas the termites' wings are of nearly the same size. Both ants and termites live in large nests or colonies, made up of different forms or castes. In these nests or colonies both wingless and winged mature individuals are produced. Unlike the other forms, the brownish or blackish, elongate, slender, antlike, colonizing, sexual adult termites with long whitish wings have functional eyes, and their bodies are able to endure full sunlight. These migratory males and females appear normally once a year during a short period.

1/ Paper presented before the New Orleans Academy of Sciences, Gibson Hall, Tulane University, November 22, 1934.

Among both the ants and the termites there is a well developed polymorphism or caste system of fertile and sterile forms, with a division of labor. Fossils show that the caste system appeared early in the development of termites, and they thus became social insects, whereas roaches did not.

Where are Termites?

Termites occur in all zoogeographical regions of the world, except the Arctic and Antarctic. The Ethiopian region is the richest in species, and the Neotropical, Oriental, and Australian regions also have many species. The Palaearctic and Nearctic regions have few termites. Thus termites are not confined to the tropics, but occur in temperate regions throughout the world. The 50° parallels of latitude and the mean annual 50° F. isotherms outline the distribution of termites in the world.

There are 1,997 different known species of termites in the world, including 65 fossil species. In the United States there are 56 living species of termites and 9 fossil, and living termites have been found in all states except North Dakota. In Arizona 25 species occur, 20 in Texas, 19 in California, 15 in Florida, and 8 in Nevada; other states have from 1 to 5 species. Only 5 have been recorded from New Mexico, doubtless because of lack of thorough investigation.

Throughout the United States, especially in the Southern, Central, Southwestern, and Pacific Coast States, native termites, or white ants, cause serious damage to the foundations and woodwork of buildings, to articles in the buildings, and to living trees, crops, and other vegetation.

When are Termites?

Our knowledge of the earlier types of termites, as represented by fossils, is incomplete, but termites are not recent. A fossil wing in Miocene rock of Washington indicates a 55-million-year residence in North America. Termites antedated man; roaches antedated both termites and man. Both probably will survive man, because of better adaptability. Fossils occur in the Eocene and Miocene formations of the world in rock, Baltic amber, and gum copal. Also, fossil termite pellets have been found in Florida, in the more recent Pleistocene formation.

Termite damage in the past has often been mistaken for decay or dry-rot caused by fungi; it is therefore apparent that the amount of damage caused by termites is greater than it was formerly believed to be. There has been no introduction or spread of termites from the tropics to the United States, nor has there been any spread of our native forms from the Southern to the Northern States. The species are different in the various regions. Examinations of the old colonial dwellings in Virginia which have been attacked and reattacked by termites over long periods, lead some authorities to believe that there are "biologic waves" or periodic rises and falls in the activities of termites, or cycles of greater or lesser damage. But termites have always been here.

As colonies, termites may far outlive man. In South Africa, natives of the Transvaal have venerated certain termite mounds for hundreds of years; the mounds have remained unchanged through the centuries. In the United States, termite queens have been kept alive in artificial colonies for 25 years.

Origin of Castes

Polymorphism, or the caste system, in which both fertile and sterile forms occur, has challenged the explanations offered by many exponents of the theory of evolution. A natural explanation is that the castes have originated as segregants from a heterozygous parent form. Not only are there both fertile and sterile forms, but several types of each, including large-winged, "short-winged" (or forms with wing pads), and wingless, as well as intermediate reproductive forms. There are several types of sterile soldiers and workers. Termites colonize new sites by flight and may reach a height of 3,000 feet. They also form new colonies by creeping migrations underground. Primitive wingless roaches colonized by creeping migrations above ground. When the queen of a termite colony dies, monogamy may be replaced by polygamy, with a consequent change in the type of reproductive form. Cross breeding of three types of sexual adults within the species occurs both in nature and in artificial colonies, but the type of progeny resulting from these crosses is as yet undetermined. The worker caste developed from the soldier. The recent inhibition theory is that mature reproductive forms produce a substance which, when eaten by nymphs, inhibits the functioning of reproductive organs in individuals of the same sex. There is a constant exchange of exudates. Tropical queens become 4 inches long; they are immobile and are imprisoned in a cell. Queens of species native to the United States are small, mobile, and have a low rate of egg laying.

Origin of Flight

Termites possibly developed flight through first soaring as do other flying animals. The oldest and most primitive insects--the Palaeodictyoptera--had lateral notal growths on the prothorax. Such pronotal wing buds are not found on any mature recent insects, but occur on the young of living species of primitive termites. These lobes disappear before the adult stage is reached. These and other morphological and biological data appear to indicate that the development of individual termites--their ontogeny--is a recapitulation of the development or phylogeny of the termite group.

Development of Defense Organs

Among primitive termites the mandibles, or jaws, of soldiers are strong and saw-toothed; they are designed solely for defense, and cannot be used for chewing wood; in consequence soldiers have to be fed by other castes, as do all types of soldiers. In the intermediate termites a frontal head gland appears as well, often with an elongated, grooved labrum. This is a defense organ, from which exudes an acidulous secretion, that can be ejected for a distance of about an inch. This sticky liquid serves to "gum up" their ant enemies when they attack, or come in contact with, the termites. In the highly specialized termites, only traces of the mandibles remain, or they disappear and the gland becomes very well developed. Chemical or gland warfare is much more effective than war with mandibles in repelling the attacks of ants. In some species, instead of the functional biting mandibles of the generalized lower termites, there are elongate asymmetrical mandibles with which the termites audibly flip or snap themselves out of danger; or it may be that these mandibles are merely signalling organs to warn the colony of danger. There is much about these insects that is still unknown.

Nests

Termites were architects and engineers long before man appeared on this planet. Their domiciles were developed through about the same stages as man's, or vice versa. Primitive termites excavated nests in wood or soil, as do all of our species in the United States. The nests of our native termites are diffused and inconspicuous, and the insects move about with changing environment. In the tropics, termite nests are concentrated and often strikingly conspicuous. Here mounds and carton nests in trees, often of odd shapes, dot the landscape. By progressive development, ventilated, air-conditioned, rain-shedding nests appear with the specialized higher termites. Ants, their dominant enemy, have forced termites to dig in, or to wall themselves up in fortresses. The increased termite damage in New Orleans is due not to the control of the Argentine ant but to the lowering of the water table by man.

Termite nests house queer, oddly-shaped insect guests, or inquilines, which live in a symbiotic relationship, thereby obtaining greater warmth or coolness as well as protective shelter. Many diverse groups of animal life, as weird in form as the specialized, toothless animal predators, occur in this manner.

Food

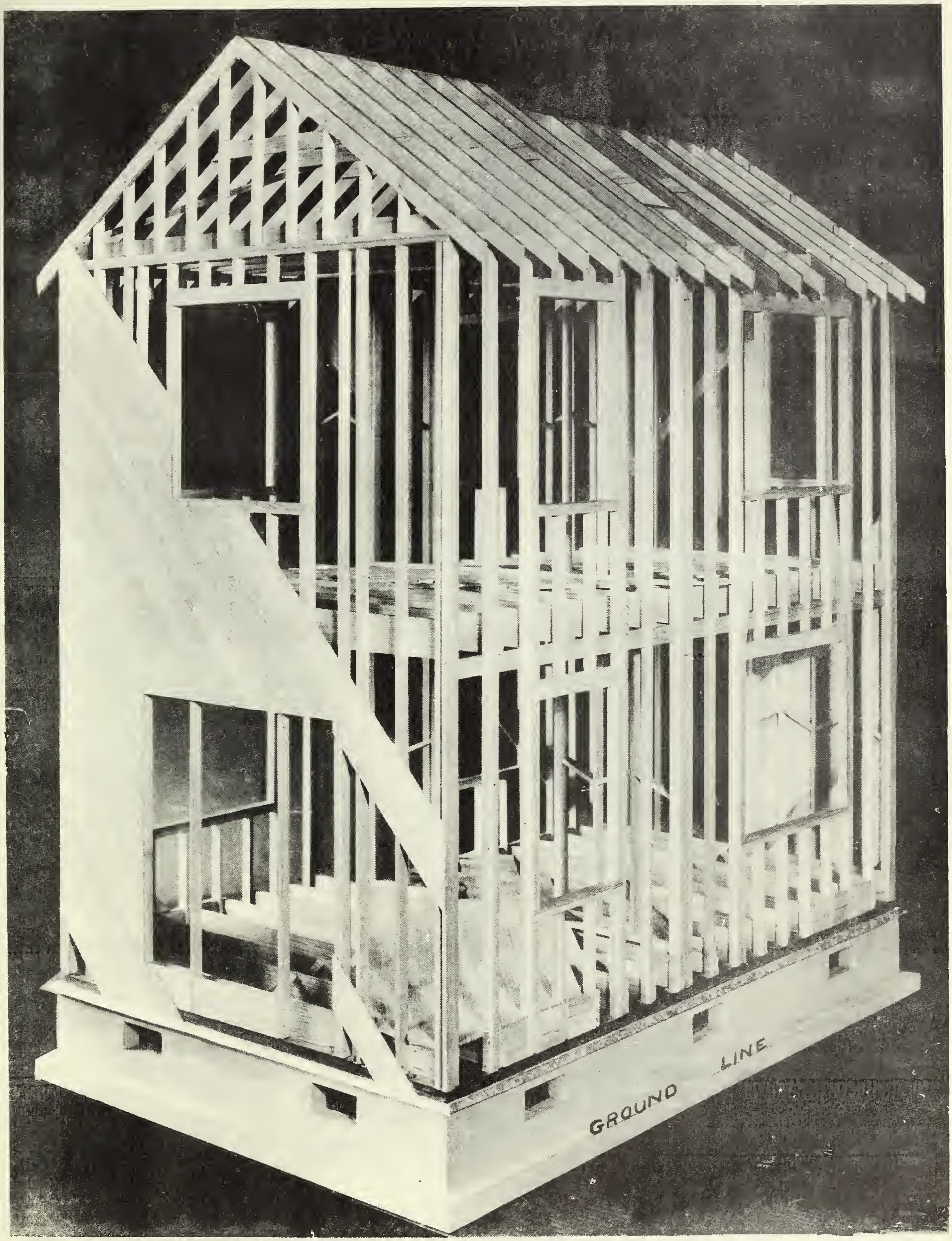
Wood affords termites both food and shelter; its chief constituent, cellulose, is their principal food. Intestinal protozoa in many termites contain enzymes that digest cellulose. The death of these symbiotic protozoa may furnish the necessary nitrogen. With our present knowledge, we can only surmise that these soft-bodied termites, whose bodies are full of juices, must have a wonderful chemical laboratory in their bodies; otherwise certain forms (dry-wood termites) could not live in very dry wood, or without the element nitrogen. It must be that, directly or indirectly through low plant and animal parasites in their intestines, they manufacture water from the air and cellulose, as well as fix atmospheric nitrogen into forms available to them as food; for animals must have nitrogen in order to live. Termites cannot obtain nitrogen from their normal food, which is derived entirely from vegetation.

The role of some of the more primitive and minute organisms found associated with termites is not known. Spirochaetes, intermediate between plants and animals, occur in the intestines of termites, but it is not known what their relation is to the termites. They do not benefit the termites, as do the protozoan Amoebae and Flagellates, which contain enzymes that digest cellulose (the basis of the structure of plants). There is some evidence of a correlation between the evolution, or development through geological time, of these intestinal protozoa and that of the host termites. Not all termites, however, have these helpful protozoa in their intestines.

Subterranean termites carry moisture with them from the soil, often to great heights on trees in their earth-like shelter tubes. Partially dominant, diurnal "wander termites" forage above ground and have color and eyes. Specialized tropical termites grow fungi or mushrooms, or forage for lichens. In the United States, our nonwood-boring termites of the Southwestern States feed on cellulose that has been broken down by fungi or other agencies.

Tropisms

When man studies social insects, he must not be egotistically anthropocentric. We do not know how insects "feel," "taste," "smell," "hear," or "see."



View of a model termite-proof building suitable for construction in the Southern States. Note the metal termite shield and proper ventilation openings. This model was especially constructed by the Southern Pine Association in consultation with the Bureau of Entomology and Plant Quarantine.

We are only sure that these functions are quite different from those in man. In insects, taste and smell may be combined or the reactions may be purely chemical. Insects react to both internal and external stimuli. Such behavior is termed a tropism. At the time of the "swarm" termites behave very queerly. Ordinarily, while in their tunnels, they shun the light or lack of humidity. Yet in the colonizing flight they emerge into the sunlight, climb to elevations, and fly. After the flight, which is followed by the shedding of their wings, they seek shelter in earth under wood. From animals that choose close quarters in the soil, cling to the earth, and avoid light, they change to animals that seek the light, avoid close quarters in the soil, and seek elevations, and again change these three reactions to the earlier condition--all within a few hours.

Damage

By man's disturbance of the balance of nature in felling and clearing forests and woodlands, his cultivation of the fields, and the encroachment of civilization, evidenced by more extensive building operations, drainage, and irrigation, termites have been forced from their natural habitats and have been driven to attack the woodwork of buildings for both food and shelter. Man has changed the status of termites from the role of scavengers to that of pests. A loss of 40 million dollars annually is a rough estimate of termite damage in the United States; there are no accurate figures.

Ninety-five percent of termite damage in the world is caused by the subterranean type. Practically all damage can be avoided by proper construction. Termites are selective feeders and choose the most suitable species of wood, etc., for food. Much damage by termites to materials such as shoes, lead-sheathed cable, and other substances not containing cellulose is due to the fact that these materials were in the way. Damage to rifles, razor blades, and other impenetrable materials is caused by the corrosive action of moisture brought up by subterranean termites with the earth and excreted wood with which they build tunnels or runways over these metals.

Control

BIOLOGICAL CONTROL.--As termites live protected lives, always concealed either in wood or in the earth and as their powers of reproduction are enormous, they have very few effective natural enemies. Unlike most insects, they have no internal insect parasites which help to keep them in check. Fungi, nematodes, and molds, however, cause some loss in termite colonies. Of these enemies, molds appear to be the most effective. Among predacious animals, ants are the most important enemies of termites. Ants are active and run about on the surface of the ground. Termites and ants in nature, however, live side by side, and ants do not control termites, mainly because termites are nearly always under cover.

ARTIFICIAL CONTROL BY MAN.--On the basis of studies of the classification and biology of the termites of the world, we can reduce the 1,997 known species to two types: (1) Dry-wood termites and (2) ground-nesting or subterranean termites. In a discussion of control measures, we can disregard all other types.

Insulating untreated wood from the ground by means of concrete or metal barrier shields offers both permanent prevention of, and a remedy for, damage by the ground-nesting forms. The impregnation of construction timbers with chemical wood preservatives is the most effective method of preventing damage by dry-wood termites. Buildings can be termite-proofed at a relatively small cost--from 1 to 2 percent of the initial cost in the case of subterranean termites, and 10 percent of such cost in the case of dry-wood termites. City building codes with brief termite-proofing provisions in the mandatory sections, as recommended by the Bureau of Entomology and Plant Quarantine, are the logical answer to the termite problem.

Recent investigations have shown that where structural changes are impractical, poisoning of the soil about the foundations offers promising results.

Caution against Exaggerated Fears

Without desire to minimize the damage that may be occasioned to buildings and their contents by termite attack, especially if long continued, it should nevertheless be pointed out that serious termite injury to buildings, particularly in the more northern parts of the Temperate Zone, is relatively infrequent; and that termite work may go on for years without involving the necessity for extensive repairs or reconstruction of foundation timbers and flooring. Many instances could be cited of old houses, dating back to colonial times, in which the presence of termites has been known for 50 years, probably for two or three times that period, without radical injury resulting. Such immunity is due, in part, to the more massive timbers used in these older types of houses, the foundation beams of which were often large and hewn from the mature centers of hardwood trees.

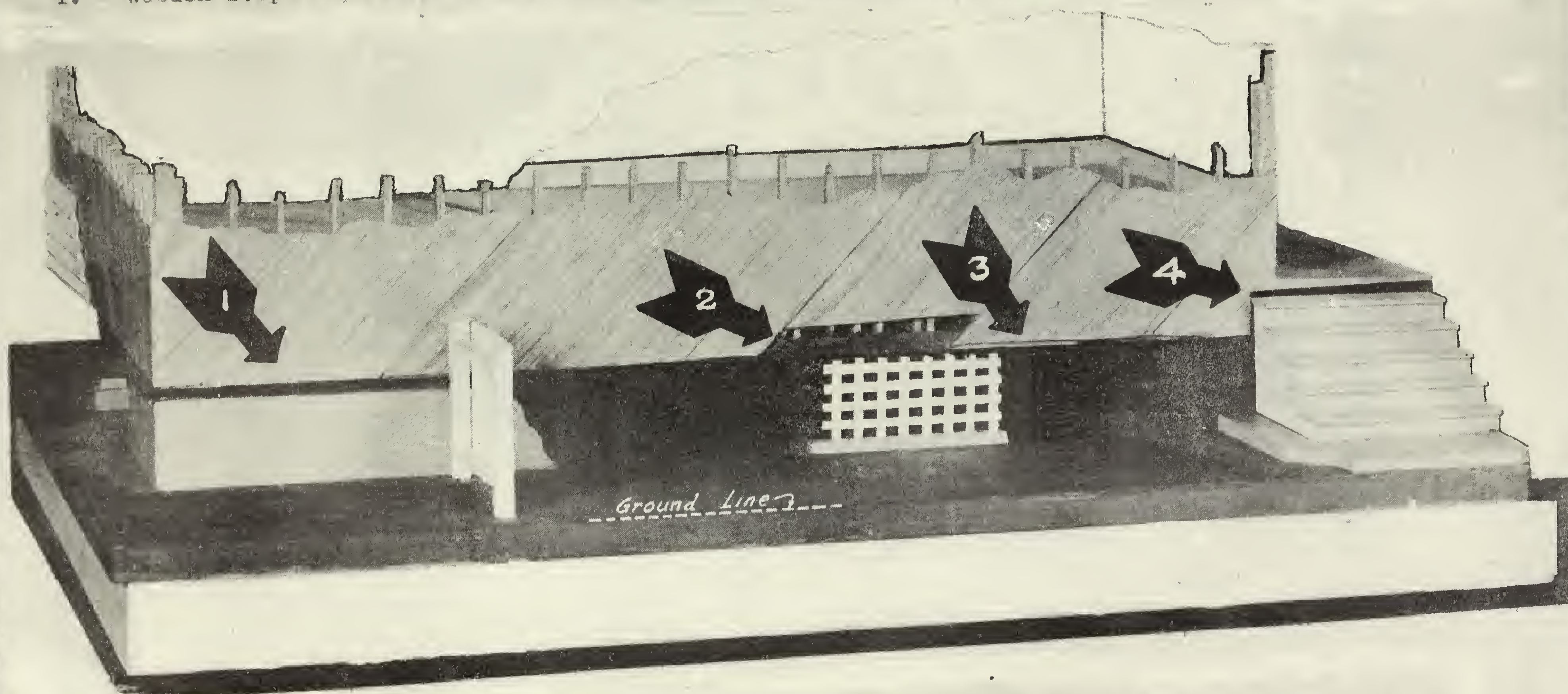
Once having invaded a building, however, termites will continue their work and extend their damage slowly or rapidly, unless and until their means of entrance from the outside has been removed by effective reconstruction. With the breaking of the connection between the building and the external soil moisture, all the subterranean termites in the building promptly die and injury ceases.

While, therefore, the risk of sudden collapse of any fairly well-constructed building, solely from termite injury, can be dismissed as very rare in the United States, the discovery of termites in a building, as indicated either by swarming or by yielding flooring and timbers, certainly indicates the desirability of having an examination made to determine what means should be taken to stop damage.

Conclusion

Each section of this paper has shown that there is a vast lack of knowledge of the biology of these insects, and with this in mind, you can imagine how one feels when a visitor, seeking information, introduces himself by saying, "I have come to you, who know everything about termites." The purpose of this brief address is to stimulate interest in termites. Details on their control can be obtained by writing to the Bureau of Entomology and Plant Quarantine, Washington, D. C., or to the Southern Forest Experiment Station.

1. - The metal termite shield inserted over concrete foundation; foundation wall ventilation openings should be 2 sq. ft. per 25 lineal feet; the wooden fence should be isolated from the woodwork of the building.
2. - Mud sill impregnated with coal tar creosote.
3. - Metal shield over concrete capping on brick foundation pier.
4. - Wooden steps separated from woodwork of building by a metal sheet.



Model constructed by the Southern Pine Association, in consultation with the Bureau of Entomology and Plant Quarantine, to show the various types of masonry foundations for frame buildings suitably capped at the top and equipped with metal termite shields. The fence and steps are isolated from the house and lattice work is on a concrete base.